COMPOSITE-CONSTRUCTION TREATMENT EQUIPMENT

This invention relates to composite-construction treatment equipment, which is designed to be set in connection with a moving surface and which equipment includes

- a frame arranged in the vicinity of the said surface,
- a blade holder formed of a composite material as an essentially integral component and connected to the frame,
- a blade adapted to the blade holder, including an edge arranged to be set in contact with the moving surface by moving the blade holder, and
- a separate backing blade adapted to the blade holder, set to the blade holder by one end while the other end extends closer to the said edge than the blade holder.

In the present treatment equipment blade holders manufactured entirely of a composite material have been in use only for a short period of time. One known blade holder located in a paper machine has an arm section by which the blade holder is attached to a frame formed by a beam. The arm section is extended with a clamp section, which is fitted with a gap for the blade. A composite-construction blade holder is light in weight and durable compared to conventional metal blade holders. The blade holder can also be made more adaptable to the surface for example by orientating the reinforced fibers. In spite of this, the blade holder is rigid in the blade loading direction, i.e. in the machine direction. In addition, the composite-construction returns to the original shape even after major deformations.

Conventionally the blade holder is attached to the frame using screws. This requires removing the screws during the installation and change of the blade holder, which takes time and requires working inside the paper machine. In some cases even the whole treatment equipment needs to be removed from the paper machine for installing the blade holder. In addition, the

holes required by the screws in the arm section create discontinuity points in the blade holder construction reducing thus its durability.

The object of this invention is to provide novel composite-construction treatment equipment, which is easier to use and service, yet more versatile than heretofore. The features characterizing this invention become evident from the appended claims. In the treatment equipment according to the invention, due to the novel design, the whole blade holder can be changed in a simple manner. This makes the installation and change of the blade holder quick and easy. Irrespective of the unexpected construction, the blade holder can additionally be provided with loading elements, for example. The blade holder can also be easily retrofitted in existing treatment equipment without major modifications. On the other hand, the design of new treatment equipment can be made simpler than before. In addition, with suitable dimensioning and design the components of the treatment equipment can be changed independent of each other, which allows to precisely adjust the treatment equipment characteristics as desired.

The invention is described below in detail by making reference to the enclosed drawings, which illustrate some of the embodiments of the invention, in which

Figure 1 is a side view of the treatment equipment according to the invention arranged in connection with a moving surface,

Figure 2a is an enlarged view of the blade holder illustrated in Figure 1,

Figure 2b is a cross-sectional view of a modification of the blade holder shown in Figure 2a without a blade,

Figures 3a-3d illustrate various applications of the blade holder according to the invention,

Figure 4a is a cross-sectional view of the blade holder according to the invention equipped with loading elements,

Figure 4b shows the blade holder of Figure 4a only,

Figure 5a shows another application of the treatment equipment according to the invention,

Figure 5b shows another application of the blade holder equipped with loading elements.

Figure 1 shows the treatment equipment according to the invention adapted in connection with a moving surface 10. Here the moving surface 10 is a paper machine roll 11, of which only a part is shown. Generally the purpose of the treatment equipment is to treat a moving surface. In the doctoring example, the purpose of doctoring is to remove impurities from the surface or, for example, the web itself in some paper machine positions. In paper and board machines and in other forming machines, moving surfaces also comprise the surfaces of various cylinders and fabrics. The treatment equipment is used for example for web coating, in which a coating paste is applied to the surface of a moving web. This is illustrated in Figure 5a. Furthermore, the treatment equipment comprises a frame 12, arranged in the vicinity of the surface 10 to be treated. In Figure 1 the frame 12 is a beam 13, which is supported by a shaft 14 in a way that allows pivoting in relation to the paper machine construction. In practice, the beam is locked in the correct position using turnbuckle screws, for example (not shown). On the other hand, the beam can be pivoted towards the surface by means of loading elements for improving the doctoring result.

The treatment equipment also includes a blade holder 15, which is made of a composite material to form an essentially integral component. The advantages of this type of blade holder are described below in greater detail. The blade holder 15 is correspondingly attached to the frame 12 (Figure 1). The actual

treatment is provided by the blade 16 adapted to the blade holder, the dimensioning and material of which can vary between different applications. In the proposed applications both the doctor blade and the coating blade are described. The blade 16 includes a doctoring edge 17, which is arranged in contact with the moving surface 10 by moving the blade holder 15. In this way the moving surface is provided with a treatment. Figure 1 shows a so-called rigid blade holder 15, in which the movement of the blade holder 15 is created by pivoting the beam 13. The proposed blade holders 15 also comprise a separate backing blade 18, which is set in the blade holder 15 by one end. Correspondingly, the other end of the backing blade 18 extends closer to the said edge 17 than the blade holder 15 thus supporting the blade 16. The operation of the backing blade is also described below in greater detail. The blades 16 shown in the figures are new. In a worn blade the edge is to the other direction. On the other hand, a bevel corresponding to a worn blade can in practice be pre-ground to the blade. In Figures 1 and 5a the movement direction of the surface 10 is indicated by the arrow.

According to the invention, the blade holder 15 is unexpectedly removably adapted to the frame 12 using a pair of form-locking counter clamps 19. The form-lock between the counter clamps 20 and 21 is additionally arranged tight in the lateral direction of the blade 16 and essentially free in the longitudinal direction of the blade 16. This allows moving the blade holder in the longitudinal direction of the blade, i.e. in the cross direction of the machine. In practice, for example in a paper machine, the blade holder can be installed simply by pushing from the side and correspondingly, it can be removed by pulling it out. In spite of this quick clamping the form-lock is tight in the lateral direction of the blade. This ensures that the blade holder is reliably kept in place in the machine direction. For additional security during the operation, the cross-machine directional mobility can be prevented using a locking

pin, for example. On the other hand, this cross-directional mobility can be utilized for oscillation with appropriate material selections. That is, the blade can be moved in relation to the surface by moving the blade holder only. All parts are preferably made of a composite material. Consequently, the scratching effect of metal rivets, for example, can be avoided.

In the proposed treatment equipment the first counter clamp 20 forming the pair of counter clamps 19 is a profiled shoulder. Correspondingly, the second counter clamp 21 is adapted to cover the first counter clamp 20 essentially on the opposite sides. In this way the said second counter clamp 21 forms a groove against the first shoulder-like counter clamp 20. In principle the location of the counter clamps can vary. However, in the blade holder the counter clamp is preferably arranged in the rear part parallel to the blade holder. In this case the blade is attached to the front part of the blade holder. Here the front part refers to the blade holder part, which is nearest to the surface to be doctored. With the proposed construction of the counter clamps, the blade holders can be freely positioned, and the blade holder can be designed optimal as regards loading and blade attachment. At the same time, disadvantageous projections, which would gather impurities and be sensitive to damage, are avoided.

Existing frames are usually provided with threaded holes for attaching the blade holder. In this case the attachment of the blade holder 15 is easy using an adapter component 22 according to the invention. Generally one of the counter clamps forming the pair of counter clamps is thus arranged in a separate adapter component, which is to be attached to the frame. The fastening screws are illustrated with broken lines in the figures. The first embodiment of the adapter component 22 is illustrated in Figures 1, 2a and 2b. Here the adapter component 22, together with the frame 12, forms the counter clamp 21 for the shoulder-like counter clamp 20 formed in the blade holder

15. The proposed construction is extremely compact, and the adapter component 22 is easy to attach to the frame 12. In addition, the arm sections of even the known composite-construction blade holders can be modified into shoulder-like counter clamps using suitable machining methods. In practice, however, it is more preferable to bring the blade holder to the final state in connection with the manufacture, thus maintaining an integral blade holder construction. The same reference numbers are used for functionally similar parts.

The following embodiments of the adapter component 22 are shown in Figures 3a and 3b. Here one of the counter clamps 20 or 21 is completely formed in the adapter component 22. In this way the adapter component 22 can be permanently attached to the frame 12. In Figure 3a the adapter component 22 is provided with a shoulder-like counter clamp 20 while the groove-like counter clamp 21 is located in the blade holder 15. This ensures that the form-lock is well protected from impurities. In addition, the blade holder 15 can be designed advantageous as regards the manufacture. In the treatment equipment shown in Figure 3a the adapter component 22 has also a curve 23 for compensating the change of the blade 15 position with respect to a conventional blade holder. Due to the adapter component 22 the blade 16 extends closer to the surface 10, in which case the blade angle α of the blade 16 relative to the surface most often changes. According to Figure 1, as the length of the blade holder 15 increases, the blade angle α decreases, which usually has a negative effect on the doctoring result. This problem can be avoided by moving the blade holder in the vertical direction, or it can be at least avoided by adjusting the beam and its position. If required, the adapter component provided with a curve can be installed in the frame also the other way round. The straightness and shape of the curve can also vary between different applications.

For example, when manufacturing new treatment equipment according to the invention, the adapter component can be excluded. This is possible by arranging one of the counter clamps 20 or 21 forming the pair of counter clamps 19 in the frame 12. This is shown in the embodiments of Figures 3c and 3d. In particular the blade holder 15 shown in Figure 3d can be made extremely short, which allows its positioning in confined positions.

Today also adjustable blade holders are used, in which the frame keeps its place as the blade holder turns. In addition to the above-described rigid blade holders, the blade holder according to the invention can also be arranged adjustable. Generally the counter clamps forming the pair of counter clamps are arranged as a mutually functional articulation. In this case it is possible to change the angle between the counter clamps while keeping the locking in the blade's lateral direction unchanged. The embodiment of an adjustable, or rather of a loadable blade holder 15 is shown in Figure 4a. The principle of this blade holder 15 is corresponding with that of the blade holder 15 shown in Figure 3a, except that the counter clamp 21 of the blade holder 15 is made more spacious. This ensures that the form-lock is maintained while the movement is still possible. For defining the movement, there are loading elements 24 between the counter clamp 20 and the blade holder 15. In the embodiment shown in Figure 4a the loading elements 24 are placed between the adapter component 22 and the blade holder 15.

The positioning of the loading elements may be difficult due to a confined construction. The lack of space can be avoided by arranging at least one provision in either or both of the counter clamps for the loading elements. In Figure 4a the blade holder 15 has such provisions on both sides of the adapter component 22. The upper provision has a loading hose 26, known as such, and the lower provision has a spring component 27. Figure 4b illustrates both the upper provision 25 and the lower

provision 25' in more detail. The treatment equipment in question is so adapted that the spring component 27 tends to turn the blade 16 upwards. Correspondingly, the blade 16 can be loaded against the surface by adjusting the pressure in the loading hose 26. The movement of the blade holder 15 is indicated by the arrow in Figure 4a, which shows a solution that is particularly advantageous for new treatment equipment according to the invention. In this case only one loading hose is needed for using the blade holder. For the existing treatment equipment including two loading hoses, a blade holder can be selected, in which there are provisions for two loading hoses (not shown).

Figure 5b shows another embodiment of the loadable blade holder. Here, too, the blade holder 15 movement is provided by means of the loading hose 26. Correspondingly, the returning force is produced by another loading hose 26' or a spring component 27. Here the adapter component 22 extends to both sides of the frame 12. The fastening is secured with screws.

The design of the blade holder according to the invention allows using different blades. Figure 3a illustrates a thick plastic blade and Figures 3b-3d show thin metal or composite material blades. Due to the blade holder design, thin blades can be fastened using several different methods. In Figure 3c a conventional rivet 28 is used, whereas in Figure 3b a composite blade has been attached using a special adapter 29. In a similar composite blade shown in Figure 3d there is an extension 30 in the rear part that is larger and different in shape, in which case a separate adapter is not necessary. For the blade 16 the blade holder also has a gap 32, defined, besides the backing blade 18, by the clamp 33.

In the treatment equipment, the function of the backing blade, too, is essential. According to the invention the backing blade 18 is similar to the blade 16. In addition, the end of the

backing blade 18, which is to be adapted to the blade holder 15, has a form-lockable detent 34 for fastening the backing blade 18 removably to the blade holder 15. In this way the backing blade, like the blade holder, has a quick clamping system, allowing its replacement. Furthermore, in selecting and manufacturing the backing blade, it is possible to utilize the know-how and production methods related to the blades, which simplifies the manufacture of the treatment equipment and reduces costs.

Figure 2b shows an application related to the backing blade 18. Here the blade holder 15 has two fastening points 31 for the detent 34 for adjusting the position of the backing blade 18 in the lateral direction of the blade 16. That is, the blade holder 15 has two alternative fastening points 31 for connecting the backing blade 18. In this case it is possible, for example, to use backing blades of two different dimensional classes in the blade holder. Secondly, the groove formed by the fastening point 31 can be used for example for supplying a lubricant to the blade and further to the surface to be treated. Also, it is possible to adapt a pipe, for example, in the groove for the lubricant preventing thus application of pressure to the blade holder. In addition, the pipe can be easily sealed and the lubricant dosing is accurate.

In total, the manufacture of treatment equipment according to the invention is less complicated than heretofore. Preferably all parts are manufactured using the pultrusion method. This ensures that the components are ready for use without major machining operations. In addition, when using the pultrusion method, reinforced fibers can be set in the component in a specified manner. Preferably there are remarkably fewer reinforced fibers in the cross-machine direction than in the longitudinal direction of the machine. In this way the blade, backing blade, blade holder and even the adapter component, if any, adapt to the shapes of the surface to be doctored. That

is, the entire treatment equipment is controllably flexible in the cross direction of the machine. This eliminates vibration problems of the treatment equipment and uneven blade wear, among other things. In addition, the known micro-screws designed for profile control are unnecessary. Instead, the major part of reinforced fibers is found in the longitudinal direction of the machine, in which case the treatment equipment can be loaded against the surface. That is, the components are rigid for transferring the force.

The above-described construction also enables a quick adjustment of the treatment equipment. Various types of blade holders can be attached to the frame and similarly, various types of blades and backing blades can be quickly replaced in the blade holders. In this way it is possible to obtain a suitable combination for each situation by changing the components. Due to the removable backing blade, the blade holder can additionally be entirely cleaned. This is easy also on the outside of the machine, as the whole blade holder can be simply removed from the machine.

Composite-construction treatment equipment is advantageous as regards the operation as well. Firstly, for example the tested blade holders weigh only 3 kg/m, in which case bending due to their own weight is nonexistent. In addition, the blade holder can be installed in the treatment equipment manually without cranes or other supports. Furthermore, the composite-construction endures well sudden impacts and returns to the original shape in spite of even major deformations. On the other hand, when damaging, the composite-construction breaks totally at once functioning thus as a special safety fuse. In case of damage to the blade holder, it can be quickly replaced with a new one without a lengthy unoperative state of the treatment equipment. Damaging also saves other constructions of the treatment equipment. The operation of the treatment equipment can also be easily monitored by installing diaphragm sensors,

for example, between the blade and the backing blade for determining the loading pressure profile.

The treatment equipment according to the invention is simple to manufacture, yet versatile to use. In addition, installing the treatment equipment and changing its components is quick, which reduces production breaks. In particular, the blade holder is light in weight, and therefore its storing and especially handling is easy. Also, in using the blade holder, less force is required than before. Another significant aspect is also the possibility of combining various components into a combination appropriate for each situation. Consequently, the desired doctoring result is obtained in each position, also when the geometry of the position changes, for example, when changing in a certain position a roll, whose diameter differs from that of the previously used roll. In addition, the treatment equipment can be reset during a grade change shutdown even when changing the production parameters, which is impossible in the known treatment equipment.